sufficiently a current is passed through the oxide by the wire (*B*). Within this circuit is a coil (*G*) which upon becoming magnetic draws down the iron bar (*E*), thus lowering the now incandescent magnesia from within the cylinder. Upon breaking the circuit the coil loses its magnetism, and a spring (*F*) raises the iron bar and magnesia to their former positions.

As advantages over the ordinary incandescent lamps Professor Nernst claims that the same amount of light can be furnished at one-third the cost, and as the magnesia allows of being heated to a much higher degree than a carbon filament a purer light is obtained. The successful employment of a cheaper substitute for the platinum is also announced, though the name is not made public. In operating, either an alternating or direct current is used.

H. Monmouth Smith.
Hampden-Sidney, Va.

Botany at the Anniversary Meeting of the American Association.

II.

The Biology of Cheese Ripening. Professor S. M. Babcock and Dr. H. L. Russell.

The most important changes which occur during the ripening of cheese are those which affect the casein, this being gradually transformed, from the firm, elastic and insoluble conditions found in a green cheese, into the plastic and more or less soluble substance peculiar to a well-ripened product. The early explanations of these changes were purely chemical, but since the discoveries of Pasteur and others in the field of fermentation they have been attributed entirely to bacteria and other micro-organisms. Duclaux suggested that the changes in the casein were due to digesting organisms. Later observers have shown that such organisms fail to develop in competition with the lactic acid type of bacteria, which are by far the most prominent species found in normal cheese. This type appears to be unable to digest casein to any considerable extent when grown in sterilized milk, unless their activity is greatly prolonged by neutralizing the acid as it is formed, in which case again the conditions do not conform to those found in normal cheese. Moreover, the ripening changes in cheese progress at a nearly uniform rate for a long time after bacterial development has greatly declined. The authors of this paper were unable to reconcile the many apparent discrepancies of the biological theory of cheese ripening until they attempted to sterilize milk for their experiments by the addition of mild antiseptics, such as ether and chloroform, which could afterwards be removed and thus avoid changes which might be produced by boiling the milk. Such milks, although sterile, passed through changes similar to those that occur in cheese. As the agents used in this case discriminate between organized and unorganized ferments, it is evident that milk contains an unorganized ferment capable of digesting casein. This enzyme is inherent in the milk itself. The authors have given to this ferment the name *galactase*, and they believe it plays an important rôle in the proteolytic changes that occur in the ripening of cheese.

Fermentation without Live Yeast Cells. Katherine E. Golden and Carleton G. Ferris.

This paper first summarizes the rather extensive and contradictory literature, beginning with E. Büchner in 1897, who claims to have induced active fermentation of various sugars with a sterile extract obtained from dried yeast by filtration through a Berkefeld filter. Büchner's method was followed in the preparation of the yeast. In filtering, the fluid was first passed twice through three thicknesses of

filter paper, and then through two thicknesses of parchment paper. The filtered fluid appeared clear and opalescent, but on microscopic examination live cells were found. A filter was then made by putting two thicknesses of filter paper in a glass funnel and coating with about ½ inch of gypsum. The funnel was then fitted into a flask and the whole sterilized. The filtrate from this was clear, but also contained a few live cells. The filtrate remained clear for three days and then became clouded from growth of yeast and bacteria. The same results were obtained from a gypsum filter an inch thick. A porous cup was then used with an aspirator to hasten filtering. Using this filter a sterile extract was obtained. This was tested in 10 and 20 % cane sugar, dextrose and wort solutions, but no fermentation took place in any of them. The experiment was repeated three times and at 37.5°C. as well as at room temperatures, with negative results in every case. The experiments were then repeated with another compressed yeast which also gives vigorous fermentation, but with negative results in every case. Inasmuch as Büchner now states that only certain yeasts possess this property, it is desirable that he should name and describe the yeast or yeasts which he used.

Deterrent Action of Salt in Yeast Fermentation. KATHERINE E. GOLDEN.

THESE experiments show that sodium chloride in any but minute quantities retards fermentation and indicate that where a sponge is used, and a quick fermentation desired, the salt should be added in the last stages. Experiments were made on sponges and stiff doughs at three temperatures, 23°, 37° and 40°C. The following table shows the increments of fermentation in inches, by half hours, in long test-tubes, the temperature being negligible:

No. of Exper.	Per cent. of salt added.	Increments of fermentation in inches.			
		½ hour.	1 hour.	1½ hours.	2 hours.
a	0	.666	1.375	1.708	1.583
b	1	.542	1.292	1.625	1.625
c	2	.456	1.200	1.500	1.666
d	3	.354	.958	1.375	1.375
e	4	.313	.875	1.250	1.375
f	5	.146	.292	.438	1.666

Experiments in fermentation tubes, using 25 cc. volumes of Pasteur's solution with cane sugar, and equal quantities of yeast (1 gram of dry yeast cake) and varying quantities of salt, gave the following results: In the control tube the fluid was driven from the closed end in 23 hours; with 4% salt the fluid was driven out in 37 hours; with 8% salt, in 38 hours; with 12% salt, in 47 hours; with 16% salt, in 7 days.

Leaves of Red Astrachan Apple immune from the Attack of Gymnosporangium Macropus. PROFESSOR W. J. BEAL.

RECORDS failure of disease to spread from infested cedar trees to two young Astrachan apple trees, purposely planted near, and also negative result of several inoculation experiments, all made in 1897. In 1898 experiments were repeated with same result. States that Professor L. R. Jones, of Vermont, has had the same experiance.

Notes on Stewart's Sweet Corn Germ, Pseudomonas Stewarti n. sp. DR. ERWIN F. SMITH.

ABSTRACT omitted on account of its length. See Proceedings of the Association; also a reprint from the same.

A Bacteriological Study of Pear Blight. LILLIAN SNYDER.

THE greater part of this paper describes a non-parasitic organism which was found associated with *Bacillus amylovorus* in blighting trees. This organism is white and on solid media its colonies closely resemble those of pear blight. It also resembles the latter morphologically. Both germs grew

slowly in cornstarch cooked in water, and sugar was not formed. Both change cellulose to sugar and the non-parasitic one gives a slow fermentation when the cellulose is made up with peptone. In pure moistened cellulose the growth of both was very slow and sugar was not formed in either case. Both prefer high temperatures. It differs from the pear blight germ in the following ways: Feeble growth in healthy tissues and no symptoms of blight (young twigs and unripe fruits of the pear and quince). In unripe fruits it was alive at the end of ten days and in some cases had extended to the opposite side of the fruit and into the seeds. Mixed in water in equal parts with the pear blight germ and inoculated into twigs, blight ensued, but when the tissues were examined, at the end of ten days, only *B. amylovorus* was found, although several attempts were made to isolate the other germ.

Unlike pear blight, it ferments potato broth, pear broth and cane-sugar solution, with a copious evolution of gas. A large fermentation tube of Smith's solution yielded about 200 cc. of gas in 10 days. This consisted of 6.2% nitrogen, 61% carbon dioxide and 32.8% hydrogen. The growth in broth made by cooking unripe pears in water was slower than that of *B. amylovorus* and in 48 hours the fluid became a deep green. In peach broth made in the same way the same deep green color appeared and zoogloeæ were quite abundant. The writer has not been able to discover zoogloeæ in cultures of the true blight bacillus. In potato broth this germ grew much more rapidly than *B. amylovorus* and gas production began in a few hours.

This organism is best obtained by placing pieces of tissue in bouillon. The same or a similar germ was also obtained by washing the surface of healthy twigs into bouillon or Smith's solution. One which turned pear broth green was also obtained from the surface of grains, especially wheat. By means of platinum needle transfers from the interior of freshly blighted twigs the true bacillus of the blight may be separated with less danger of contamination. The fact that this germ does not apparently injure the trees when inoculated into them, also that it is obtained by washing the surface of healthy twigs, proves that it has no essential connection with the disease, and renders it probable that it is a surface germ. This work was carried on in the laboratory of Dr. J. C. Arthur, at Purdue University.

Life History and Characteristics of the Pear-Blight Bacillus. Merton B. Waite.

Beginning in the spring, the germs on the new growth first appear on the nectar disks of the blossoms. The bacilli live and multiply in the nectar and are able to enter the nectar glands without a puncture or injury, and thus normally get inside their host. The distribution from flower to flower and tree to tree is through the agency of insects, mainly flower-visiting sorts. Infection also occurs on the young shoots, and less frequently on the fleshy bark through injuries. Insects and birds are agents of distribution and inoculation in these cases. No evidence has been found that the germs are carried by the wind. The organism usually dies out in the twigs which are blighted and dead, but in certain cases the germs manage to keep alive during the summer by making slow progress in the fleshy living bark. Such cases may succeed in living over winter. Winter weather is favorable to the longevity of the organism, on account of the moisture and low temperature. These cases of 'hold over blight' start off again in spring and exude quantities of gummy matter full of the bacilli. This is visited by insects, especially flies and wasps, and is carried onto the newly opened flowers, thus completing the cycle of the year. In brief, the characters of the germ are as follows: An

oval, rod-like bacillus, 0.6 to 0.8 by 1 to 6 μ, constant in diameter, but varying greatly in length. Occurs singly, or in young cultures in pairs, chains or masses. Stains readily with the ordinary aniline dyes, either in water or alcoholic solution. Has no capsule, but is supplied with several flagella scattered over the surface and is actively motile. Does not produce spores. On nutrient beef and potato broth produces first a strong turbidity and a slight granular pellicle, which breaks up and settles to the bottom. The color of the mass is milky white on all solid media. On agar plates the surface colonies at ordinary temperatures (18° to 20° C.) reach a diameter of about 1 mm. in 48 hours and at the end of a week become 5 to 6 mm. across. A temperature of 36° to 37° C. starts the growth more promptly, but results in a feebler ultimate development. The addition of malic or citric acid in small amounts so as to feebly acidify the agar increases the vigor of growth, while an excess of alkali diminishes it. On gelatine made from the common brands the opposite effect is produced. Gelatine should be neutral to phenolphthalein to insure vigorous development. There is a moderate liquefaction in good gelatine cultures. A moderate growth is made on sterile cooked potato cylinders. In the fermentation tube it decomposes sugar without the formation of gas. It is most vigorous with maltose, the cultures becoming strongly acid, and is slightly less so with cane sugar, dextrose and laevulose. It is aerobic and facultative anaerobic. It produces no pigment or coloring matter of any sort, and no odor. It does not decompose starch. Its principal food consists of nitrogenous matter, sugars and probably to some extent certain organic acids—to wit, the substances found in young growing tissues of its host. Certain statements formerly made are known to be erroneous. The germ mass was said to be yellowish-white on potato. This could only come from an impure culture, as the true pear-blight germ is always white. Gas, or in some places carbon dioxide gas, is said to be formed. This never occurs. Butyric acid is said to be one of the products of its decomposition. The germ produces acids, but never butyric. Starch is said to be decomposed and used as food, but, so far, the author has not been able to demonstrate this. The germ is said to live over winter in the soil. The author has failed to find it in the earth, and its life cycle is complete without such hypothesis.

On the Occurrence of a Yeast Form in the Life Cycle of Sphæropsis malorum. PROFESSOR WM. B. ALWOOD.

PAPER records the discovery of a yeast form in laboratory cultures of this fungus. On isolation and inoculation on the fruit of the apple the common fruit bodies characteristic of *S. malorum* made their appearance.

Some Steps in the Life History of Asters. PROFESSOR EDWARD S. BURGESS.

THIS paper presents results of field-studies of Aster variations made during the last twelve years. Its purpose is to review certain known terms in the ontogeny of Asters which are liable to misinterpretation. These sources of confusion are of three classes, the first of which is the number of leaf-forms normally developed at once upon a single stem. There are eight principal forms:

a. Primordial leaf, usually roundish and transient.

b. Radical leaves, two or three or more, often progressively different.

c. Lower cauline leaves, usually the most characteristic.

d. Middle cauline leaves, usually transitional in shape.

e. Upper cauline leaves, usually much smaller.

f. Axile leaves, subtending the primary axils.

g. Rameal leaves, on primary branches.

h. Bractlets, on the ultimate branches.

According as one or the other of the parts of this leaf-series is more strongly developed, or is suppressed, the plant will change aspect and may be mistaken for a new species. The other two sources of confusion now to be considered are the normal and the accidental, or less usual successive terms in the life-history of the species. These are here treated together, distinguished by number and letter, the normal or usual by the letter *N*, the accidental or less usual by the letter *A*.

N^1 Seedling stage, usually with two small radical leaves.

N^2 Radical-tuft stage, often conspicuous, often remaining some years before developing into N^3.

A^1 Oval-topped stage, frequent in Biotian Asters, the normal cordate radical tuft becoming topped out with the smaller, thinner, oval or other non-cordate leaves.

A^2 Plantain-leaf stage, an occasional extreme development from the last, the non-cordate leaves becoming the predominant ones, and often resembling *Plantago major* in size and shape.

N^3 Cauline stage, normally following N^2, the radical tuft sending up an erect leafy stem which bears six of the eight leaf-forms already mentioned. But instead of taking this normal course of development, the plant may enter upon any one of the following seven stages which are enumerated as accidental or less usual.

A^3 Intercalary stage, when one or more little leaves are interpolated into the series with much larger leaves above and below.

A^4 Arrested stage, when the gradually diminishing normal series of cauline leaves meets sudden arrest from which it never recovers, a succession of little leaves now continuing into the inflorescence.

A^5 Sprout form, usually with leaves somewhat different in form and size from the type.

A^6 Ramified or branch-leaf form, when, after suppression of the main stem, one or more branches rise to replace it, with new direction, and the leaves larger and more numerous, but the leaf-form remaining true to the branch-leaf type for that particular species.

A^7 Bifurcation, either in leaf or stem, arising apparently not from accident, but as a sport.

A^8 Opposite leaf state, due to suppression of internodes, especially upon abnormal branches.

A^9 Verticil form, three nodes brought together in inflorescence or rarely in the leafy stem.

N^4 Aestivation, the budding stage; often a very different aspect is taken here from that before or after.

N^5 Flowering stage, beginning with erect terete rays, which are soon tubular by involution, and in anthesis may change greatly, according as the following progressions become developed or not:

a. Pedicels lengthen, changing sessile buds into long-pedicelled flower-heads, and dense branches into loose clusters.

b. Cymose development may prolong the outer branches so as to overtop the central and original inflorescence.

c. Rays flatten across, becoming flat and rounded.

d. Rays change position from erect to horizontal, and finally recurved, incurved or pendulous.

e. Rays change color with age to white, greenish or brownish.

f. Disks change color early from yellow to red, reddish-brown or brownish.

g. Disks change from flat to dome-shaped.

h. Pappus changes color by yellowing, darkening or reddening.

A^{10} Enfeebled state, after close cutting

down; when the new stems rising from the same root-stocks the next year are often shorter, weaker, scantier and paler in inflorescence and less varied in leaf.

N^6 Resting stage, when, instead of the preceding (N^5) or after it, the root-stock develops radical leaves only for a series of years.

N^7 Surculus stage, a lateral offshoot, arising from the preceding root-stock, rising and making ready to enter upon the radical-tuft stage, N^2, and renew the round of the life-history.

Specific distinctions are hardly to be found in the constant absence or presence of any of the less usual stages, but rather in the relation the plant bears to them when they are found, the ease with which they are induced or thrown off, and the shapes assumed when induced. Some species habitually elide one or more terms in the series, some accelerate them, some prolong or accentuate them. An exceptional development does not invalidate a specific character, as its possibility is latent in all.

The Embryology of Taxus. E. J. DURAND.

IN this paper the development of the female prothallium is traced from one of an initial axial row of about three cells. The nuclei which result from the division of the nucleus of the macrospore arrange themselves in a peripheral layer, and walls are formed between them so that the young prothallium is in the form of a hollow sphere, the center of which gradually becomes solid from the ingrowth of the cells. The archegonia are developed at the distal end of the prothallium. The neck of the archegonium consists of four cells, instead of one, as is usually stated for this plant.

Effect of Fertilizers on the Germination of Seeds. GILBERT H. HICKS.

THE tests were made with the seeds of wheat, lettuce, radish and crimson clover. The conclusions reached are as follows:

1. One per cent. strengths of muriate of potash and of sodium nitrate are very detrimental to seeds, whether applied directly or mixed with the soil.

2. Fertilizers composed of phosphoric acid or of lime are much less injurious to germination, and if not used in excess may be harmless.

3. Commercial fertilizers should not be brought into direct contact with germinating seeds.

4. The effect of treating seeds with chemicals before planting is no index to the action of those chemicals when applied as manures to the soil.

5. The chief injury from chemical fertilizers is effected upon the young sprouts after they leave the seed coat and before they emerge from the soil, while the seeds themselves are injured only slightly or not at all.

6. It is highly improbable that potash, phosphoric acid, nitrogen or lime used as fertilizers actually favor germination.

The Pleistocene and Plant Distribution in Iowa. DR. T. H. MACBRIDE.

THIS paper offers a new explanation for certain peculiarities of distribution characterizing the flora of that prairie State. It appears that certain plants, especially northern species, are not only very rare in Iowa, but are in their distribution limited to very small and far-separated areas. No existing conditions seem to offer any explanation. Recent study of the pleistocene geology of the State brings to light, however, the fact that these isolated stations for Iowa's rarer plants are all of them *driftless* areas, *i. e.*, areas entirely exempt from glacial deposits. So remarkable is the coincidence that we may confidently say that wherever the geologist finds a driftless hill-top there certain plants are sure to occur and *vice versa*. The paper was illustrated by a map.

Observations on some Hybrids between Drosera intermedia and Drosera filiformis. Professor John M. Macfarlane.

The author reported the discovery and described the appearance of a number of Droseras which are morphologically intermediate between the species named, in number and position of the flowers, number and shape of the leaves, scales, etc., so that he thinks there can be no reasonable doubt as to the occurrence of hybrids between these two species. Drawings were exhibited and explained.

On the Validity of the Genera Senna and Chamæcrista. Charles L. Pollard.

A record of further observations on the structure of the flower of *Cassia Chamæcrista*, on the floral arrangement of which Professor E. L. Greene commented in a recent issue of *Pittonia*. He found that the corolla exhibits a torsion of 90° to the left and thereby differs materially from that of *Cassia* proper. Other characters were adduced to prove the distinctness of the two genera.

Species Characters among the Violets. Charles L. Pollard.

Development of the Pollen Grain in Symplocarpus and Peltandra. B. M. Duggar.

Division of the primitive archesporium is of the vegetative type, and the number of chromosomes present is that of the whole number of the sporophyte. The resting nucleus of the definitive archesporium has a large nucleolus taking the chromatin stain in the Flemming combination. The reticulum is a loose net very slightly chromatic. In the cytoplasm there is no differentiated zone of kinoplasm. The contracted state of the chromatin thread in the late reticulum or early spirem was found abundantly at a definite period in the life-history of these cells prior to actual division. In this condition staining is difficult, and the return from this phase is characterized especially by a loosening of the ribbon in one perfect coil, thus truly imitating the spirem. The spirem ribbon becomes nodulate, and finally segmentation is preceded by a bending back of the ribbon at definite points and the disappearance of the chromatin along the connecting linin. The formation of the spindle is multipolar and the chromosomes are centrally as well as peripherally arranged. The nucleolus is peculiar in assuming various shapes and in showing linin connections with the general ribbon. The first division, in general, indicates that there is a longitudinal division of the chromosomes, although in Symplocarpus there is a suggestion that the first division may be the reducing division and hence transverse. In the second division the daughter segments separate longitudinally in both cases. There is no return of the nucleolus prior to the second division, but a true dispirem is formed. This is in accord with studies on Liliaceæ, but differs from what is found in some dicotyledonous plants. In the division of the microspore nucleus the nucleus migrates to one side of the cell and the entering kinoplasm forms a multipolar somewhat barrel-shaped spindle. This finally becomes completely attached at one pole, forming a truncated cone, while the other pole of the spindle may be truly conical. This fixity of the spindle causes the unequal division of the cell body, necessitating the small generative cell. This method of division (fixity of one pole) seems to be characteristic of such divisions in many plants.

Notes on the Embryo-sacs of Certain Monocotyledons. K. M. Wiegand.

Recent investigations by Dr. Wiegand tend to show that the two extreme types of embryo-sac formations as illustrated by *Lilium* and *Canna* are related in a manner not before observed. In *Convallaria*, which represents the transitional type, a septum is formed after the first division of the hypodermal nucleus, but not after the second.

This represents an axial row of four cells with two septa omitted. The remaining septum at length breaks down, so that a single cavity containing eight nuclei results. The single cell of *Lilium* is, therefore, derived from the four axial cells of *Canna*, not primarily through the omission of any divisions of the mother cell, but by the absence of the septa.

Studies Relative to the Perigynium of the Genus Carex. K. M. WIEGAND.

THREE theories have been advanced as to the homology of the perigynium in the genus *Carex*. By Bentham and others it was considered to be composed of two united bracts. Schleiden considered it to be a modified perianth; but the most plausible theory is that advanced by Pax, Dyer and Kunth, who emphasize the fact of its close resemblance to the prophyllum of other monocotyledons. In many cases the secondary axis within the perigynium develops to such an extent that several rudimentary flowers are formed in addition to the fertile one. The perigynium is, therefore, not a perianth. The position of the odd carpel, which is turned toward the main axis of the spike, and the development of the perigynium from two posterior teeth, seem to indicate that the perigynium is, indeed, a modified prophyllum.

Rapidity of Circumnutation Movements in Relation to Temperature. E. SIMONS and R. E. B. MCKENNEY.

FIVE species were experimented with, viz.: *Phaseolus vulgaris, Humulus lupulus, Convolvulus sepium, Lonicera brachypoda* and *Wistara sinensis*. Darwin also experimented on these plants, but gives few exact details as to temperature. The average there in England is 15° or 16° C. in spring and 20° to 23° C. in summer. In this paper no account is taken of the relative intensity of the light, although data are being gathered which prove that this is an extremely important factor. In dull cold days, with temperature at 15° to 19° C. movements were found to be *extremely* slow. The average optimum for best results was 28° C. In *Convolvulus sepium* two distinct types of stem were observed, a rapidly circumnutating and a prostrate one showing extremely feeble movements. In the results obtained by the writers it is safe to assume that the temperature was on the average 12° C. higher than that worked in by Darwin, and in most cases the periods of revolution are very considerably shorter, but at present it would be rash to say that the higher temperature is the sole or even the main determining factor in the more rapid movement. Light intensity and hygrometric conditions of the atmosphere have been found to cooperate also, but present indications are that temperature is a very important factor, and that an optimum as well as a maximum and minimum temperature exist for each species.

General Characteristics of the Duneflora of Southeastern Virginia. THOMAS H. KEARNEY, JR.

REPORT of a preliminary survey of the plants of the coastal plain with reference to their ecological distribution. The soils, heat, light and other physical conditions were first described. The principal plant groups were thus described with an enumeration of some of the more evident adaptations by which the plants were brought into harmony with the physical conditions.

Vegetation of the Wooded Fresh-water Swamps of Southeastern Virginia. THOMAS H. KEARNEY, JR. (Read by title.)

Notes on Arctic Willows. PROFESSOR W. W. ROWLEE.

THE Cornell party on the Peary expedition of 1896 brought back an exceptionally good collection of willows on which this paper is based. The glaucoid and myrtilloid

groups, which are perhaps the most difficult to segregate, have several interesting forms. This paper attempts to characterize the forms of *Salix glauca* L. and *S. grœnlandica*.

A Self-registering Transpiration Machine. Edwin B. Copeland.

Description of a very simple and easily operated apparatus, consisting of a wheel over which runs a string carrying the plant tested on one end and an areometer on the other. As the plant loses weight, the counter weight, the areometer sinks. The record is kept as with an auxanometer. One day's record was presented to illustrate the working of the machine. To be published in *The Botanical Gazette*.

Methods of Studying the Sap Pressure of the Sugar Maple. Professor L. R. Jones.

After some unsatisfactory experiments with the common mercurial gauge, a self-recording steam-pressure gauge (which was exhibited) was substituted with very good results. Lithium passed upward and downward in the maples very rapidly, but there was very little sidewise movement of this substance.

Notes on the Physiology of the Sporophyte of Funaria and Mnium. Dr. Rodney H. True.

The growth rate of the sporophyte of these mosses may be represented by a rather flat curve rising somewhat more gradually than it falls. Subsequent to the breaking loose of the calyptra from the gametophyte, growth is confined to the distal end of the sporophyte, and the growing region, about 2 mm. long, is entirely enclosed by the calyptra.

The calyptra, much developed in *Funaria*, less so in *Mnium*, is a protective structure chiefly useful in preventing desiccation. In *Funaria* the cells of the calyptra are living and contain chlorophyll grains. They are probably self-supporting as regards nutrition until the rupture of the calyptra.

The curvature of the seta in this species results as a response to the stimulus of gravitation. In the earlier stages of its growth the seta is not sensible to this stimulus, but becomes so as the time for the development of the capsule approaches, and by use of the mechanism of growth executes the curvature.

The direction of the strongest illumination determines the radius in which the capsule shall fall. In *Mnium* the capsule falls with great regularity away from the direction of the strongest illumination, thus exposing the end of the capsule bearing the stomata to the light. Occasionally some fall directly toward the strongest light, but very rarely out of that plane.

Funaria obeys, with much less precision and regularity, the same rule. The conduct of these mosses varies in accordance with the nature of the situations which they are wont to occupy.

The Seeds and Seedlings of some Amentiferæ. W. W. Rowlee and Geo. T. Hastings.

As compared with the other groups of angiosperms the Amentiferæ have been, so far as their seeds and seedlings are concerned, very indifferently observed. Finding this to be true led the authors of this paper to grow seedlings of the native representatives of the group. Their studies have led to the following conclusions: 1. The cotyledons in *Juglans* and *Hicoria* correspond with the valves of the nut, and are deeply two lobed. The two divisions of the embryo resembling cotyledons are each made up of halves of the cotyledons. 2. The seeds of *Hicoria* germinate without frost action; those of *Juglans* only with frost action. 3. The tap-root is very thick in young seedlings, and very long in in older ones. 4. In *Castanea* and *Quercus* the shell is split by a swelling of the coty-

ledons in germination. 5. In the species of *Quercus* studied, the leaves of the seedlings were much alike, and not deeply cut or lobed. 6. *Fagus* is the only genus in which the hypocotyl lengthens, or the cotyledons become aerial.

The paper was illustrated by two plates; one showing the peculiar division of the cotyledons in *Juglans* and *Hicoria*, the other various seedlings of the group.

The Morphology and Taxonomic Value of the Fruits of Grasses. P. BEVERIDGE KENNEDY.

THE presence of an epiblast and a plumule sheath distinguishes the embryo of the Gramineæ from that of other monocotyledons. About eighty genera were investigated to determine the constancy, morphological significance and taxonomic value of these peculiar organs. In general, species of the tribes Maydeæ, Andropogoneæ, Zoysieæ and Tristeginæ are without epiblasts, while those of the tribes Oryzeæ, Agrostideæ, Aveneæ, Chlorideæ, Phalarideæ, Festuceæ, and perhaps the Bambuseæ possess epiblasts. Peculiar exceptions occur in some tribes, *e. g.*, the Hordeæ appears to have equally as many with as without epiblasts. From study of the perfectly developed epiblasts in *Zizania*, *Leersia* and *Oryza* the author is led to believe that the epiblast is a second rudimentary cotyledon opposite to the scutellum (cotyledon). The plumule sheath is constant in all embryos, and from his study of the vascular system, together with Hanstein's investigations on the development of the embryo of Brachypodium, the author believes that it is a ligule-like growth belonging to the scutellum and is homologous with the ligule of the fully developed grass leaf. Unlike Bentham and Haeckel, he is inclined to believe that the Bambuseæ and Oryzeæ together represent the most primitive grasses. The Oryzeæ resemble the Bambuseæ as follows: 1. They show great variation in the structure of their fruit and spikelet. 2. They possess remarkably large epiblasts. 3. Some have the same number of lodicules. 4. *Pharus* has a style with three stigmas. 5. Many of the genera have broad petiolate leaves and transitions between these into linear leaves. 6. To a great extent they have the same geographical distribution, the larger number of the genera being indigenous to tropical America. According to Haeckel's classification, the tribes Zoysieæ, Tristeginæ, Andropogoneæ, Maydeæ and Paniceæ, both according to the characters of the fruit and those of the inflorescence, form another natural group joined to the Oryzeæ through Zoysieæ and Tristegineæ. The Chlorideæ, although regarded by Haeckel and Warming as being removed some distance from the Andropogoneæ, have been found like them in their fruit characters. Judging from their fruit characters, the remaining tribes, Phalarideæ Agrostideæ, Aveneæ, Festuceæ and Hordeæ form another natural group in the order named, and this coincides with the classification given by Haeckel.

To avoid a session Thursday evening, the following papers were read by title:

The Caryopsis of the Gramineæ. PROFESSOR L. H. PAMMEL.

The Ecological Distribution of Colorado and Wyoming Plants. PROFESSOR L. H. PAMMEL.

Fertilization of the Muskmelon Flower. PROFESSOR WM. F. RANE.

Notes on Destroying Comptonia asplenifolia. PROFESSOR WM. F. RANE.

Length of Time from Blossoming to Seed Development in Leucanthemum vulgare. PROFESSOR WM. F. RANE.

The Work Performed by the Agricultural College toward a Botanical Survey of Michigan. PROFESSOR W. J. BEAL.

SEVEN additional titles appeared on the

preliminary program, but were omitted from the regular program because no abstracts were furnished.

Erwin F. Smith,
Secretary.

SURVEYS OF THE GATEWAYS TO ALASKA.

A beginning has at last been made in the accurate mapping of the delta of the Yukon, one of the great rivers of the world. Through the courtesy of Superintendent Pritchett we are enabled to give a preliminary account of the work done in that locality during this year and to advert to further operations of the Coast Survey at the head of Lynn Canal, another of the gateways to the interior of Alaska and the British Yukon district.

On June 30th the U. S. Coast and Geodetic Survey party arrived in St. Michael, Alaska, and immediately began preparations for the survey of that part of the delta of the Yukon River bordering on the seacoast.

The prime object of this expedition was to examine the delta of the Yukon River with the purpose of finding out what depth of water exists on the bars in front of the delta and to locate such channels as were found flowing from the mouths of the river into Bering Sea. This problem necessitated the execution of a scheme of triangulation upon which to base the required topography and hydrography.

While the two small steamers required for hydrographic work off the delta were being fitted out by a section of the party at St. Michael the other members were engaged in triangulating and mapping the coast from St. Michael southward to the the Aphoon (pronounce Ap-hoon) mouth of the Yukon, and in making a detailed survey of the towns of St. Michael, Healy and immediate vicinity. This detail map proved of much value to the military authorities of St. Michael Military Reservation in settling the matter of boundary lines between the commercial companies located there.

The channel and bar of the Aphoon mouth of the Yukon River were surveyed and developed. This is the channel that has always been used by steamboats for getting into the river from St. Michael.

While this work at the Aphoon mouth was in progress another small party had gone on one of the small steamers to the Kusilvak mouth of the river, establishing a latitude and longitude station well inside of the coast line. From this station it proceeded seaward with a topographic and hydrographic survey.

From all reports of the natives and others it seems reasonably certain that the Kusilvak mouth is the deepest of the mouths of the river, and this survey shows that it has much the greatest volume of water.

From the latter part of August to the end of the season the whole party was at work on the Kusilvak mouth of the river and southward along the coast, including and beyond the mouth of the Krypniak River. The Kusilvak mouth was found to be about twenty-five miles farther northwest than given on the most recent charts. All that can now be said of this mouth of the river is that eight feet of water can be carried into it at low tide, whereas there is only two feet at low tide on the bar at the entrance to the Aphoon mouth, the one now used by steamboats plying on the Yukon River.

From the investigations made of the Kusilvak mouth the shallowest water on the bar is from three to six miles off shore and the eight-foot channel is very crooked and difficult to follow with a vessel. It cannot be followed at all except by the constant use of a sounding lead. The use of buoys appears impracticable on account of the outflow of ice each year, which would not only carry the buoys away, but no